

STATWAY™ STUDENT HANDOUT

Lesson 3.2.4

Special Properties of the Least Squares Regression Line (Optional)

STUDENT NAME _____ DATE _____

INTRODUCTION

In this lesson, you are interested in understanding special properties of the least squares line. You will investigate and answer the following three questions about the least squares line in this lesson:

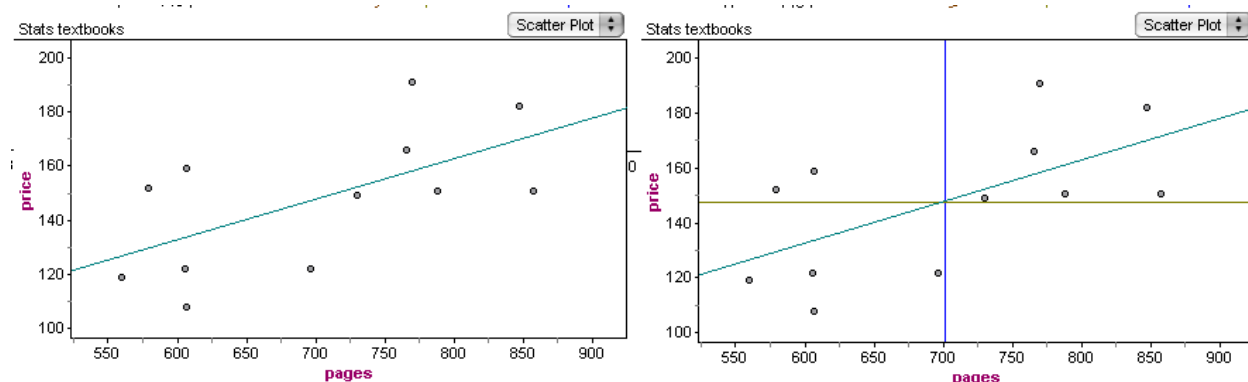
- 1 What does the least squares line predict for y when x is equal to the mean of the x values in the sample? Here is the same question written with symbols: When $x = \bar{x}$, $\hat{y} = \underline{\hspace{1cm}}$?
- 2 What does the least squares line predict for y when x is one standard deviation above the mean. Here is the same question written with symbols: When $x = \bar{x} + s_x$, $\hat{y} = \underline{\hspace{1cm}}$?
- 3 What is the connection between the equation of the least squares line and the summary statistics for x and y , such as means, standard deviations, and the correlation coefficient?

You will investigate these three questions using data on 12 statistics textbooks.

Here you have the summary statistics describing the number of pages and the publisher's list price for 12 popular statistics textbooks.

	Mean	Standard Deviation
Pages	$\bar{x} = 701.083$	$s_x = 106.402$
Price	$\bar{y} = 147.608$	$s_y = 25.718$

Below on the left, there is a scatterplot of the data and the least squares line $\hat{y} = 42.16 + 0.1504(\text{pages})$. The correlation coefficient is 0.62. On the right, there is the same graph with the addition of the two mean lines.



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TAKE IT HOME

- 1 At Los Medanos College, a statistics instructor posted the following information on her office door at the end of the semester:

Statistics FA 2010	Mean	Standard Deviation	Correlation
Pre-final exam average	75	8	0.7
Final exam score	78	12	

- A Final course grades have not been posted. So Karen wants to predict her final exam score based on this information. She has an 82 pre-final exam average. What does the least squares line predict for Karen's final exam score?
- B What statement is the most accurate advice you could give Karen?
- Before using the least squares line to predict your final exam score, you need to know that the relationship between pre-final exam average and final exam scores is linear. You are not given enough information to determine if the relationship is linear. Therefore, proceed with caution in using a line to make predictions in this situation.
 - The correlation coefficient is 0.7. This tells you that the relationship between pre-final exam average and final exam score is fairly linear. However, there will be some error in the prediction, so do not be surprised if your final exam score differs from your prediction.

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Special Properties of the Least Squares Regression Line (Optional)

- 2 In this lesson, you learned that for any least squares regression line if $x = \bar{x}$, then $\hat{y} = \bar{y}$. Explain in words what this means.
- 3 You conjectured that for the least squares line if $x = \bar{x} + s_x$, then $\hat{y} = \bar{y} + s_y$.
- A Explain in words what this means.
- B This conjecture was not true for the statistics textbook data. Would this conjecture ever be true? If so, describe the relationship you would see in the data. If not, explain why this will never be true for any least squares line.

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This lesson is part of STATWAY™, A Pathway Through College Statistics, which is a product of a Carnegie Networked Improvement Community that seeks to advance student success. Version 1.0, A Pathway Through Statistics, Statway™ was created by the Charles A. Dana Center at the University of Texas at Austin under sponsorship of the Carnegie Foundation for the Advancement of Teaching. This version 1.5 and all subsequent versions, result from the continuous improvement efforts of the Carnegie Networked Improvement Community. The network brings together community college faculty and staff, designers, researchers and developers. It is an open-resource research and development community that seeks to harvest the wisdom of its diverse participants in systematic and disciplined inquiries to improve developmental mathematics instruction. For more information on the Statway Networked Improvement Community, please visit carnegiefoundation.org. For the most recent version of instructional materials, visit Statway.org/kernel.

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